

A NEW SPECIES OF *PHYLLURUS* (LACERTILIA: GEKKONIDAE) FROM
THE KILKIVAN DISTRICT OF SOUTH-EASTERN QUEENSLAND.

PATRICK J. COUPER, BEN HAMLEY & CONRAD J. HOSKIN

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The leaf-tailed gecko *Phyllurus kabikabi* sp. nov. is described from Oakview Forest Reserve in the Kilkivan district of south-eastern Queensland. It has a very restricted distribution and is deeply divergent from its sister taxon, *P. caudiannulatus*, from which it is readily separated in morphology by lacking enlarged tubercles on the underside of the hindlimb. The Oakview Forest Reserve/State Forest area is of conservation significance, harbouring relict rainforest taxa, including the largest known population of the rare skink, *Nangura spinosa*. Potential threats to *P. kabikabi* sp. nov. include a narrow distribution and degradation of habitat through logging, feral pigs and fungal pathogens. □ *Gekkonidae*, *Phyllurus*, new species, Queensland, Australia, rainforests.

Patrick J. Couper, Queensland Museum, PO Box 3300, South Bank, Brisbane, Queensland 4101, Australia. Ben Hamley, 15 Bayford Street, Oxley, Qld 4075. Conrad J. Hoskin, School of Botany and Zoology, The Australian National University, Canberra, ACT 0200; 24 July 2007.

In late February 1997, a leaf-tailed gecko (*Phyllurus* sp.) was captured (by BH) in what was then Oakview State Forest (26° 07' 23"S 152° 19' 01"E) during vertebrate fauna surveys that were part of the Queensland/Commonwealth Government funded South East Queensland Bio-region Comprehensive Regional Assessment (Eyre et al., 1998). The collection site is currently in Oakview Forest Reserve, a protected area estate managed by the Queensland Environmental Protection Agency. The specimen was a small juvenile without a tail which made it difficult to assess its morphological affinities with other *Phyllurus* spp. In September 1997, the collection site was revisited by a team from the Queensland Museum and the Department of Natural Resources in order to collect additional material. A further six specimens were obtained, some with original tails. The geckos closely resembled specimens of *P. caudiannulatus* Covacevich from Bulburin National Park/State Forest area (24°37'05"S 151°32'37"E), 195km to the north. Geckos from both populations shared a divided rostral scale and had cylindrical tails with bold white cross bands.

Genetic analysis showed the Oakview *Phyllurus* population to be a highly divergent sister lineage to *P. caudiannulatus* (Couper et al., 2000; Hoskin et al., 2003). Couper et al. (2000) discussed the status of the Oakview leaf-tails, treating them tentatively as a divergent population of *P. caudiannulatus*, pending examination of more material and surveys of suitable habitat in areas between the Bulburin and Oakview populations.

We believe the intervening area has now been well surveyed and no additional *Phyllurus* populations have been found. An assessment of the Oakview *Phyllurus* collection site determined that the total known area of occupancy may be as little as 6.1 ha (Borsboom, 2006) and therefore no additional specimens were collected. Based on the high genetic divergence and geographic separation between *P. caudiannulatus* and the Oakview *Phyllurus* population, as well as consistent morphological differences presented herein, we here describe the Oakview *Phyllurus* as a new species.

MATERIALS AND METHODS

MORPHOMETRICS. All measurements were taken with Mitutoyo electronic callipers. The single juvenile specimen is excluded from measurements given as percentage SVL.

DEFINITIONS. Snout to vent length (SVL), tip of snout to anterior margin of cloaca with body straightened; tail length (T), from posterior margin of cloaca to tip of tail; head length (HL), mid anterior margin of ear to tip of snout; head width (HW), widest point across back of skull, corresponding with anterior upper margin of ear openings; head depth (HD), lower jaw to top of head, between eyes; snout length (S), anterior margin of orbit to tip of snout; eye to ear (EE), posterior margin of orbit to mid anterior margin of ear; neck length (NL), axilla to mid posterior margin of ear; length of forelimb (L1), insertion to tip of longest digit, with limb stretched straight

perpendicular to body; length of hindlimb (L2), insertion to tip of longest digit, with limb stretched straight perpendicular to body; axilla to groin (AG); subdigital lamellae (fourth finger, fourth toe), tip of digit to basal junction of third and fourth digits; supralabial and infralabial scale rows (from rostral and mental scales, terminating posteriorly at the angle of the mouth when the labials cease to be twice the size of adjacent granules). The distribution of enlarged tubercules was examined on the hands, feet and ventral surfaces.

SURVEYS. The Environmental Protection Agency (2007) WildNet Database was searched to determine the survey effort at localities in close proximity to Bulburin National Park (24°37'05"S 151°32'37"E) and Oakview Forest Reserve (26°07'23"S 152°19'01"E) and at latitudes between these two sites (see Appendix). The data search drew on records from multiple sources (Integrated Biological Information System, Moggill Queensland Parks and Wildlife Service Fauna Data, SEQ Comprehensive Regional Assessment

Fauna Survey Database and Wildlife Ecology - Indooroopilly survey data). Additional sites were assessed by Queensland Museum herpetologists in November 1999.

SYSTEMATICS

Phyllurus kabikabi sp. nov. (Figs 1A, 2A, 3)

ETYMOLOGY. Derived from Kabi Kabi (pronounced ear-bee ear-bee) to recognise the language group of the traditional owners of Oakview Forest Reserve. The name Kabi is derived from the traditional name Kav'ai or Kab'ai being the name for the native light grey bee and pronounced ear-by.

MATERIAL. HOLOTYPE: QMJ63857 Oakview Forest Reserve (26°07'23"S 152°19'01"E), 25 Sept 1997. PARATYPES: QMJ62817, QMJ63849-63853. Details as for holotype except QMJ62817 was collected 26 Feb 1997.

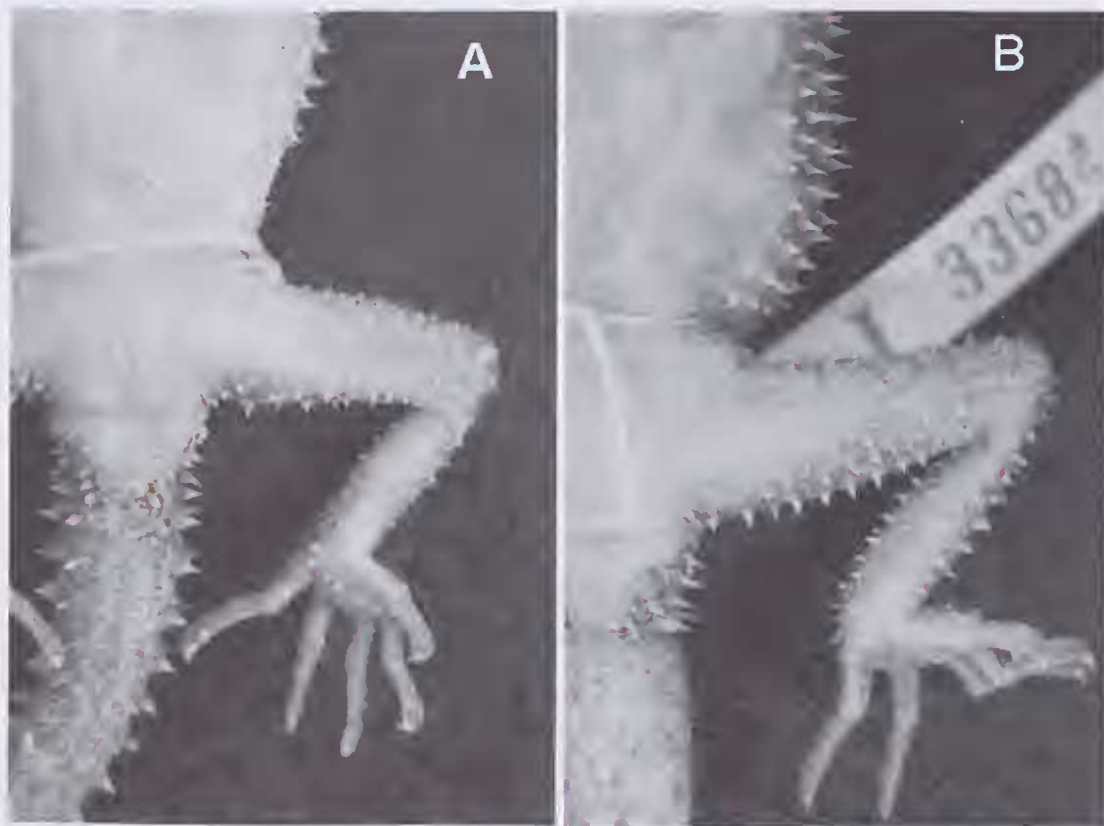


FIG. 1. Scalation on ventral surface of the hindlimb. A, *Phyllurus kabikabi* sp. nov. (QMJ63857) - enlarged tubercles absent; B, *P. caudiannulatus* (QMJ63684) - enlarged tubercles present. Also note the more spinose flanks of *P. caudiannulatus*.

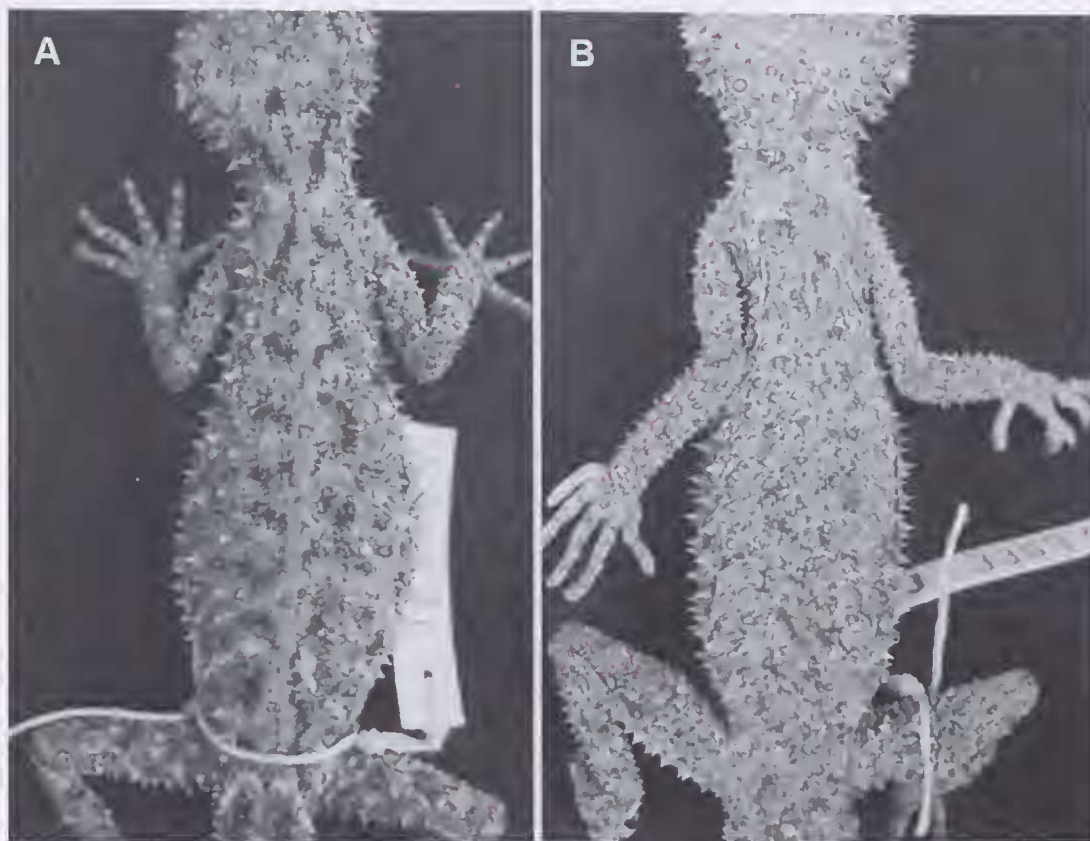


FIG. 2. Dorsal scalation of A, *Phyllurus kabikabi* sp. nov. (QMJ63857) and B, *P. caudiammulatus* (QMJ33693) showing the latter species to be generally more spinose along the vertebral line and neck.

DIAGNOSIS. *Phyllurus kabikabi* sp. nov. is separated from all its congeners by the following combined characters: tail cylindrical; rostral scale fully divided; ventral surface of hindlimb lacking pronounced, raised tubercles (Fig 1A).

DESCRIPTION. SVL (mm): 52.01 - 81.10 ($n = 7$, mean = 68.72, SD = 9.75). Proportions as % SVL: T = 70.12 - 77.83 ($n = 3$, mean = 75.14, SD = 4.35); HL = 24.93 - 28.65 ($n = 6$, mean = 27.20, SD = 1.35); HW = 21.15 - 23.10 ($n = 6$, mean = 22.64, SD = 0.74); S = 11.39 - 13.08 ($n = 6$, mean = 12.10, SD = 0.59); EE = 8.03 - 9.52 ($n = 6$, mean = 8.90, SD = 0.52); NL = 18.13 - 21.47 ($n = 6$, mean = 19.60, SD = 1.29); AG = 41.35 - 46.87 ($n = 6$, mean = 44.05, SD = 2.01); L1 = 40.65 - 44.89 ($n = 6$, mean = 43.13, SD = 1.56); L2 = 48.14 - 54.83 ($n = 6$, mean = 52.82, SD = 2.45).

Head. Large, depressed, triangular, distinct from neck; head depth 38.70 - 42.27% head width ($n = 7$, mean = 40.34, SD = 1.12); covered in

small granules intermixed with larger conical tubercles; skin of head co-ossified with skull; rostral shield fully divided by deep, vertical groove ($n = 7$); rostral shield not in contact with nostril ($n = 7$); scales between nasal openings along dorsal edge of rostral 7 - 9 ($n = 7$, mode = 9, mean = 8.14, SD = 0.90); ear opening elliptical, vertical, much less than half as large as eye; supralabials (left) 14 - 18 ($n = 7$, mode = 16, mean = 16, SD = 1.30), supralabials (right) 13 - 18 ($n = 7$, mode = 16, mean = 15.29, SD = 1.70); infralabials (left) 12 - 16 ($n = 7$, mode = 13, mean = 13.29, SD = 1.38), infralabials (right) 12 - 16 ($n = 7$, mode = 13, mean = 13.57, SD = 1.51). **Neck.** Broad. **Body.** Moderate, depressed, covered in small granules; dorsal granules intermixed with larger conical tubercles; tubercles small to moderate on back and flanks, moderate to pronounced on sides of neck; basal scales surrounding upper flank and back tubercles not, or slightly, larger than adjacent granules; ventral scales slightly enlarged in pelvic region; small

granules present on pectoral region. Preanal pores absent. Axilla deeply invaginated. *Limbs*. Long, covered in small to moderate pointed tubercles dorsally; enlarged tubercles on ventral surface of upper forelimb; underside of hindlimbs without enlarged tubercles (Fig. 2A); digits strongly compressed distally; subdigital lamellae fourth finger (left) 16 - 20 ($n = 7$, mode = 18, mean = 18.14, SD = 1.35), fourth finger (right) 16 - 19 ($n = 7$, mode = 16, mean = 17.0, SD = 1.15); dorsal surface of hand without enlarged conical tubercles; subdigital lamellae fourth toe (left) 14 - 18 ($n = 7$, mode = 16, mean = 16, SD = 1.29), subdigital lamellae fourth toe (right) 13 - 18 ($n = 7$, mode = 16, mean = 15.29, SD = 1.70); dorsal surface of foot with some enlarged conical tubercles. *Original tail*. Cylindrical, tapering and terminating in small knob. Dorsal surface with transverse rows of enlarged, spinose tubercles, 10 proximally, 8 on mid region, free of enlarged spinose tubercles for 8 - 16% of distal tail length; ventral surface with small granular scales. *Regenerated tail*. Cylindrical with granular scalation, lacking enlarged spinose tubercles; tip slightly bulbous.

Pattern. In spirit, head body and limbs fawn to mid-brown; heavily marked with irregular dark brown blotches on head body and limbs. Two pairs of small, indistinct cream blotches on either side of vertebral line; one over pectoral region, other over pelvic region (most prominent in juvenile QMJ62817 and holotype QMJ63857), but only just discernible in remaining specimens). Head with a short, cream streak running from posterior edge of orbit to angle of mouth. Toes with obscure cream cross bands. Original tail as for body, but more heavily mottled and generally of darker appearance; with 5 distinct cream cross bands (? 6 in QMJ63849) of which distal 3 extend to ventral surface. Ventral surfaces cream with faint brown 'peppering' on edges of chin and belly, and limbs; conspicuous dark 'peppering' beneath original tail. Regenerated tail heavily pigmented all over (QMJ63853, with partially regenerated tail, has a distinct 'V' shaped marking on dorsal surface).

Measurements and scale counts of holotype. QMJ63857 SVL = 81.1 mm, T (original) = 56.87 mm, HL = 20.22 mm, HW = 17.15 mm, HD = 6.87 mm, S = 9.24 mm, EE = 6.51 mm, NL = 14.7 mm, L1 = 32.97 mm, L2 = 39.04 mm, AG = 38.01 mm, Lamellae 4th finger (17 left, 16 right), Lamellae 4th toe (16 left, 16 right), supralabials (16 left, 16 right), infralabials (13 left, 12 right).

Genetics. The phylogenies presented in Couper et al. (2000) and Hoskin et al., (2003) clearly identify *P. kabikabi* sp. nov. (referred to as *P. cf. caudiannulatus* Oakview and *P. caudiannulatus* Oakview SF SEQ respectively) as the sister taxon to *P. caudiannulatus* from Bulburin National Park/State Forest area. Sequence divergence between *P. kabikabi* sp. nov. and *P. caudiannulatus* is 14.52% (399 bp cytochrome *b* mtDNA), a level of divergence comparable to that seen amongst *Phyllurus* spp. in mid-eastern Queensland (12.30% - 17.87%: *P. championae* Schneider, Couper, Hoskin & Covacevich; *P. isis* Couper, Covacevich & Moritz; *P. neptis* Couper, Covacevich & Moritz and *P. ossa* Couper, Covacevich & Moritz). Couper et al. (2000) estimated the divergence between mtDNA lineages of leaf-tailed geckos to accrue at the rate of 0.0042 ± 0.0002 per million years and suggested the time of divergence between the Oakview population (*P. kabikabi* sp. nov.) and *P. caudiannulatus* to be in the order of 30 million years. This date is comparable with the deep divergence detected in other Australian dipodactyline taxa (*Diplodactylus vittatus* complex; Oliver et al., 2007). As cytochrome *b* is likely to be saturated at deeper divergences, this estimate should be treated tentatively, but nonetheless gives some insight into the antiquity of the split between these taxa.

COMPARISON WITH SIMILAR SPECIES.

Phyllurus kabikabi sp. nov. can only be confused with *P. gulbaru* Hoskin, Couper & Schneider and *P. caudiannulatus*, its congeners with cylindrical, non-depressed, tapering original and regenerated tails. It is readily separated from *P. gulbaru* by the condition of the rostral scale (rostral fully divided by rostral groove vs partially divided in *P. gulbaru*) and the number of pale bands on the original tail (5-6 vs 8 in *P. gulbaru*). *P. kabikabi* sp. nov. is most similar to *P. caudiannulatus*, which is generally more spinose (Figs. 1-2). It is readily separated by the scalation along the ventral surface of the hindlimb (uniform granules vs granules intermixed with pronounced, raised tubercles in *P. caudiannulatus*, Fig. 1B).

HABITAT. *Phyllurus kabikabi* sp. nov. occurs in a moist semi-evergreen vine forest (Fig. 5) growing on a deep layer of broken, siliceous ash-flow tufts (A. Ewart pers. comm.) capping a ridge summit at an elevation of 540m (Borsboom, 2006). All specimens have been found at night on rock or on vegetation above rock.



FIG. 3. *Phyllurus kabikabi* sp. nov. in life, QMJ63852 (image – G. Cranitch, QM).

DISTRIBUTION. *Phyllurus kabikabi* sp. nov. is known from a single locality in Oakview Forest Reserve (26° 07' 23"S 152° 19' 01"E) SEQ (Fig. 4). A field inspection of the only collection site shows the habitat to be a narrow strip (around 120m at its widest point) covering approximately 6.1ha (Borsboom, 2006). Within Oakview Forest Reserve, there are other upland areas (totalling approximately 1000ha) with similar vegetation that have not yet been assessed for the presence of *P. kabikabi* sp. nov. However, the distribution of layered rock in Oakview State Forest is patchy and areas without the appropriate substrate are unlikely to support leaf-tailed gecko populations. The strong association between rock and *Phyllurus* spp. is clearly demonstrated in the Sydney sandstones (*P. platurus*) and at many rainforest sites in the Mackay/Townsville regions (*P. championae*, *P. isis*, *P. nepthys*, *P. ossa*, *P. amnicola* and *P. gulbaru*; Couper et al, 1993, Couper et al. 2000, Hoskin et al., 2003), and it is highly likely to be an important component of the habitat for *P. kabikabi* sp. nov..

The EPA (2007) WildNet database showed considerable survey effort in areas lying between Bulburin State Forest and Oakview Forest Reserve between January 1992 and July 1998. A significant portion of these surveys were conducted by government survey teams using repeatable survey methodologies (see Eyre et al., 1998). No additional *Phyllurus* populations were found. Of twenty five sites surveyed (including

national parks, state forests, forest reserves and conservation parks), twelve sites were scored as rainforest and six of these included a nocturnal component in the search effort. Geckos (but not *Phyllurus* spp.) were recorded from all six sites, indicating appropriate techniques and an appropriate search image for detecting their



FIG. 4. Map showing the distribution of *Phyllurus kabikabi* sp. nov. (Oakview Forestry Reserve) and *P. caudimaculatus* (Bulburin NP) in relation to other *Phyllurus* spp. in Queensland. ▽ = *P. gulbaru*, + = *P. amnicola*, ▲ = *P. ossa*, Θ = *P. isis*, § = *P. nepthys*, * = *P. championae*.



FIG. 5. Habitat of *Phyllurus kabikabi* sp. nov. at Oakview Forest Reserve. A, semi-evergreen vine forest overlying the leaf-tail site; B, rock substrate at the leaf-tail site.

presence. Geckos (but not *Phyllurus*) were also found at three additional rainforest sites where nocturnal searches were not conducted (presumably found sheltering during the day). In addition to the WildNet data, three sites were searched, by QM herpetologists in November 1999.

Reproduction. The holotype, QMJ63857 which was collected in late September has two oviducal eggs visible through the body wall. The timing of egg-laying is consistent with that observed for *Phyllurus* spp. on the Mackay Coast, MEQ (Couper et al., 1993).



FIG. 6. Habitat disturbance associated with forestry activities in Oakview State Forest. Note the semi-evergreen vine forest abutting the forestry road on right.

Conservation. *Phyllurus kabikabi* sp. nov. appears to be one of Queensland's most narrowly distributed reptile species. In addition to threats associated with a narrow extent of occurrence, *P. kabikabi* sp. nov. may be at risk from habitat degradation from forest die-back caused by the fungus *Phytophthora cinnamomi*. *Phytophthora cinnamomi* has been shown to have caused localised die-back in rainforests further north in Queensland, on the Eungella Tableland and in the Wet Tropics (Brown, 1999). It has been suggested that *P. cinnamomi* may have been introduced into some of these areas on forestry machinery (Brown, 1999), and that logging activities and feral pigs may increase the spread of the fungus within these areas (Brown, 1999; Gadek, 1999). Given the presence of ongoing logging operations in the adjacent Oakview State Forest (Fig. 6) and the presence of feral pigs in Oakview State Forest and Oakview Forest Reserve (Borsboom pers. comm.), we consider *P. cinnamomi* to be a potential threat to the rainforest at the *P. kabikabi* sp. nov. site. Significant degradation of the vine thicket at the leaf-tail site through disease or other agents (e.g. fire) would have profound consequences for the geckos, affecting moisture levels, prey abundance and other factors. *Phyllurus* species in Queensland are strongly tied to rocky habitats, but only occur where these are associated with rainforest communities. Borsboom (2006) suggested that pigs, cats, foxes and cane toads may impact *P. kabikabi* sp. nov. directly through predation, and cane toads also through food competition. Such impacts have not been assessed, but the authors consider them unlikely to be substantial given that the rugged, rocky terrain that underlies the gecko site limits access to these species.

The Oakview Forest Reserve/State Forest area has attracted considerable attention since the discovery of a significant population of *Nangura spinosa* Covacevich, Couper & James there in 1997. This distinctive, highly localised skink was previously known from a single creek line in Nangur National Park, 38km to the west. Oakview is of importance to the survival of this species, comprising 80% of its known area of occupancy (Borsboom et al., 2005). Additionally, there are concerns as to the small size of the Nangur National Park population of this skink and its long term viability (Borsboom pers. comm.). The discovery of *P. kabikabi*, and its high genetic divergence from *Phyllurus* further north, further highlights the significance of Oakview Forest Reserve and hints at the importance of this landscape as a refugium

for rainforest taxa during past climate change. Preliminary investigations also show its importance to other faunal groups. It is home to an undescribed, narrowly distributed weta (family Anostomatidae) that has only been collected from one other, geographically proximate rainforest site (G. Monteith, pers. comm.).

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APPENDIX

Sites encompassing Bulburin and Oakview State Forests and the intervening areas for which reptile records exist in the Environmental Protection Agency (2007) WildNet (Database). * = Surveyed rainforest site, 2 = nocturnal component to survey,

3 = site visited by QM herpetologists.

Eurimbula NP, 24°07'22"S 151°42'35"E*2; Dan Dan NP, 24°09'42"S 151°04'50"E*; Eurimbula Conservation Park, 24°11'50"S 151°42'45"E; Deepwater NP, 24°17'57"S 151°55'45"E; Kroombit Tops NP, 24°22'22"S*2 150°57'23"E; Mount Colosseum NP, 24°25'06"S 151°35'30"E; Broadwater Conservation Park, 24°25'55"S 152°00'16"E; Dawes NP, 24°30'23"S*2 151°13'42"E; Bulburin NP, 24°32'22"S 151°29'12"E*2; Dawes Resourees Reserve, 24°33'32"S 151°14'48"E; Glassford State Forest, 24°33'36"S 151°20'08"E; Littabella NP, 24°36'24"S 152°3'42"E; Bulburin State Forest, 24°37'05"S 151°32'37"E*2; Pine Mountain State Forest, 24°38'20"S 151°12'15"E; Watalgan State Forest, 24°39'14"S 152°01'8"E; Warro NP, 24°39'15"S 151°42'23"E; Littabella Forest Reserve, 24°39'33"S 151°58'41"E*2; Kalpowar State Forest, 24°40'37"S 151°20'33"E; Mouth of Kolan River Conservation Park, 24°40'42"S 152°12'42"E*; Mon Repos Conservation Park, 24°47'47"S 152°26'31"E; Bullyard Conservation Park, 24°58'35"S 152°03'06"E; Bania Forest Reserve, 24°58'40"S 151°30'20"E*2; Wonbah State Forest, 2 24°59'34"S 151°39'01"E; Bingera NP, 25°02'23"S 152°16'39"E; Elliott River State Forest, 25°03'24"S 152°15'31"E; Baywulla Creek Conservation Park, 25°04'03"S 151°25'41"E; Cordalba Forest Reserve, 25°06'43"S 152°05'22"E*2; Burrum Coast NP, 25°07'01"S 152°32'55"E; Cordalba State Forest, 25°07'25"S 152°07'15"E; Mt Perry, 25°13'S 151°42'E3; Nour Nour Forest Reserve, 25°15'03"S 151°26'42"E; Good Night Scrub NP, 25°16'56"S 151°54'11"E*2; Wongi State Forest, 25°27'03"S 152°25'34"E; Woowoonga NP, 25°28'34"S 152°07'0"E; Wongi NP, 25°29'47"S 152°19'35"E*; Degilbo Timber Reserve, 2 25°31'44"S 151°54'27"E*; Woocoo NP, 25°38'18"S 152°19'47"E; Mt Walsh, 25°33'38"S 152°03'20"E3; Mount Walsh NP, 25°38'20"S 152°02'30"E*2,3; St Mary State Forest, 25°40'57"S 152°27'34"E; Glenbar State Forest, 1 25°45'52"S 152°22'25"E; Mt Bauple, 25°48'30"S 152°34'00"E3; Ban Ban NP, 25°50'46"S 151°57'28"E; Teebar Forest Reserve, 1 25°51'10"S 152°04'23"E*; Grongah Forest Reserve, 25°55'45"S 152°7'54"E*2; Marodian Forest Reserve, 25°56'38"S 152°13'07"E; Woroon State Forest, 26°03'26"S 151°39'01"E; Nangur NP, 26°07'08"S 151°59'02"E*; Brooyar State Forest, 26°08'36"S 152°30'43"E; Oakview State Forest, 26°09'23"S 152°19'12"E*; Oakview Forest Reserve, 26°09'54"S 152°18'30"E*2;

Glastonbury State Forest, 26°14'51"S 152°28'57"E*; Wrattens Forest Reserve, 26°17'58"S 152°20'28"E*²; McEuen State Forest, 26°20'8"S 151°52'23"E; Wrattens State Forest, 26°21'42"S 152°21'24"E; Wondai State Forest, 26°21'50"S 151°57'31"E; Kandanga Forest Reserve, 26°24'45"S 152°25'08"E; Gallangowan State Forest, 26°26'08"S 152°20'23"E*; Upper Kandanga State Forest, 26°26'24"S 152°23'24"E.